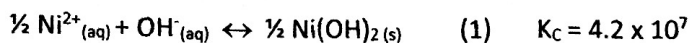


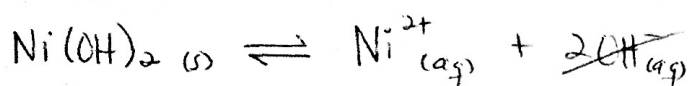
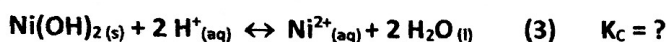
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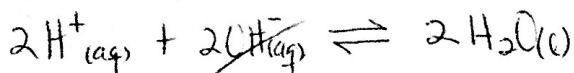
1. (6 pts.) Use the following reactions equilibrium constants:



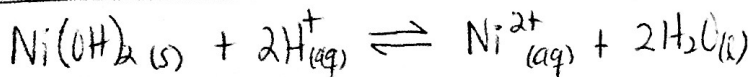
to find K for the following reaction:



$$K_1 = \left(\frac{1}{4.2 \times 10^7} \right)^2$$

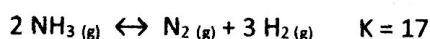


$$K_2 = \left(\frac{1}{1.0 \times 10^{-14}} \right)^2$$



$$K = \left(\frac{1}{4.2 \times 10^7} \right)^2 \times \left(\frac{1}{1.0 \times 10^{-14}} \right)^2 = 5.7 \times 10^{12}$$

2. (4 pts) Consider the following reaction:



The initial concentrations of reactants and products are: $[\text{NH}_3] = 0.50\text{M}$, $[\text{N}_2] = 0.15\text{M}$ and $[\text{H}_2] = 0.12\text{M}$. Determine the direction in which the system will proceed to reach equilibrium.

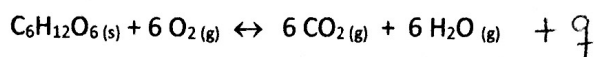
$$Q = \frac{[\text{N}_2][\text{H}_2]^3}{[\text{NH}_3]^2}$$

$$Q = \frac{(0.15)(0.12)^3}{(0.50)^2} = 1.0 \times 10^{-3}$$

$$Q < K$$

System will proceed right to reach equilibrium.

3. (7 pts.) The following reaction is exothermic.



(a) Predict the effect (shift right, shift left, or no effect) of the following:

- Removing some O_2 from the reaction mixture - shifts left
- Adding more $\text{C}_6\text{H}_{12}\text{O}_6$ to the reaction mixture - no effect
- Lowering the temperature of the reaction mixture - shifts right
- Removing H_2O from the reaction mixture - shifts right
- Adding a catalyst to the reaction mixture - no effect

(b) How would you change the volume to increase the yield of products?

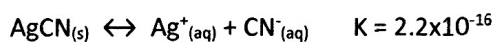
To increase yield, the system has to shift right. If volume increases, the pressure will decrease and the system will shift towards more moles of gas (right).

(c) Will the equilibrium constant of the reaction increase or decrease if the temperature is increased?

If the temperature is increased, the system will shift left.

K will be smaller (decrease)

4. (8 pts) Consider the dissolution of silver cyanide in water:



(a) Based on the value of K , is AgCN a soluble or insoluble salt? Why?

(b) Write the equilibrium expression for this reaction. Is equilibrium homogeneous or heterogeneous?

(c) Find the $[\text{Ag}^+]$ and $[\text{CN}^-]$ at equilibrium.

(d) Find K for $\text{Ag}^+(\text{aq}) + \text{CN}^-(\text{aq}) \leftrightarrow \text{AgCN}(\text{s})$

(a) $K \ll 1$ Reactants favored \Rightarrow salt is insoluble.

(b) $K = [\text{Ag}^+][\text{CN}^-] = 2.2 \times 10^{-16}$

(c)

	$[\text{AgCN}]$	$[\text{Ag}^+]$	$[\text{CN}^-]$
I		0	0
C		+x	+x
E		x	x

$$(x)(x) = 2.2 \times 10^{-16}$$

$$x = 1.5 \times 10^{-8} \text{ M} = [\text{Ag}^+] = [\text{CN}^-]$$

(d)

$$K = \frac{1}{2.2 \times 10^{-16}} = 4.5 \times 10^{15}$$